Ambient Air Quality Impact Report
West Phoenix Power Plant Unit CC4
Significant Permit Revision #S06-007
June 9, 2006

I. APPLICANT

Arizona Public Service Company
PO Box 53933, Mail Station 4120
Phoenix, AZ 85072-3933

II. PROJECT LOCATION

The West Phoenix Power Plant is located at 4606 W Hadley, Phoenix, AZ, which lies within Maricopa County.

With respect to the National Ambient Air Quality Standards (NAAQS), this location is designated as moderate nonattainment for ozone (since the 182(f) waiver is not recognized in Maricopa County for New Source Review purposes, the precursor pollutants NO_x and VOC are regulated for NAAQS purposes). The project site is under the jurisdiction of the Maricopa County Air Quality Department (MCAQD).

III. PROJECT DESCRIPTION

Arizona Public Service (APS) filed an application for a significant permit revision for the West Phoenix Power Plant (WPPP) combustion turbine unit 4 (CC4) pursuant to Maricopa County Rule 210, Section 406 of the Maricopa County Air Pollution Control Regulations (MCAPCR). The purpose of the application is to revise only the existing short term Lowest Achievable Emission Rate (LAER) volatile organic compounds (VOC) emission limit for CC4.

The Combined Cycle Combustion Turbine CC4 is a General Electric (GE) Model PG7121 (EA), or Frame 7EA combustion turbine. The combustion turbine has a nominal output of 80 MW, and a heat input capacity of 944.4 mmBtu/hr at 73 ^{o}F. The combustion turbine includes an inlet air filtration system, natural gas fuel system, dry low NOx combustors, an 18,000 volt generator, lubricating and hydraulic oil systems, and a state of the art control system. Because this is a combined cycle unit, the turbine is equipped with a heat recovery steam generator (HRSG) to recover energy from the hot exhaust gases of the turbine. Steam from the HRSG is used to produce additional electric energy in a 50 MW steam turbine/electric generator set. To provide additional electric capacity for peak power requirements, the HRSG is equipped with duct burners with a maximum heat input rating of 40 mmBtu/hr. To control carbon monoxide (CO), and possibly VOC emissions, the HRSG is also equipped with an oxidation catalyst system.

The permit revision application seeks only to increase the short-term (lb/hr) VOC emission limit for unit CC4. APS is not seeking any revision to the annual VOC emission limit (cap). The revision to increase the short-term VOC limit for CC4 is necessary because the existing permitted limit has not been achievable on a routine basis.

APS proposed to increase the VOC limit for CC4 from 1.26 lb/hr (0.00133 lb/mmBtu) to 2.4 lb/hr (0.0025 lb/mmBtu) for normal operations without operation of the duct burner and from 1.54 lb/hr (0.00156 lb/mmBtu) to 2.8 lb/hr (0.0028 lb/mmBtu) for normal operations with operation of the duct burner, all limits based on a rolling 3-hour average. These increased limits were derived by APS from an assessment of achievable LAER for similar units (GE7EA) and supporting data from source tests conducted on CC4.

MCAQD has reviewed the APS application and supplemental information for the permit revision and concluded that the permit should be revised to the following limits (slightly lower than proposed by APS):

Without duct burner: 2.27 lb/hr (0.0024 lb/mmBtu as methane), rolling 3-hour average
With duct burner: 2.65 lb/hr (0.0027 lb/mmBtu as methane), rolling 3-hour average

For reference, the above emission limits can also be expressed in terms of concentration in the exhaust stream. If one assumes that the original mass emission rates in the original permit are also as methane, the emission limits are converted to the following:

Current emission limit for turbine only: 0.00133 lb/mmBtu which converts to 1.0 ppmvd at 15% oxygen
Current emission limit for turbine plus duct burners: 0.00156 lb/mmBtu which converts to 1.2 ppmvd at 15% oxygen.
Proposed emission limit for turbine only: 0.0024 lb/mmBtu which converts to 1.8 ppmvd at 15% oxygen
Proposed emission limit for turbine plus duct burners: 0.0027 lb/mmBtu which converts to 2.0 ppmvd at 15% oxygen.

IV. EMISSIONS FROM PROJECT

Although the short term (i.e., 3-hour average) VOC emission rate (in terms of pounds per hour) is being revised for CC4, APS is not seeking, and this permit revision does not change the facility-wide emission limits on an annual basis. The annual facility-wide VOC emission limit remains as specified in Table 1 of the existing permit, 56.1 tons per year.

V. NSR

In accordance with MCAPCR 210, Section 406 this permit revision is a significant revision since an emission limit increase is being requested. This emission limit increase only affects the short term VOC limit (no change to annual limits) and is a result of an inability of CC4 to achieve the existing permit limit on a routine basis.

The facility was previously permitted as a major modification to an existing major source in accordance with MCAQDR 240 in which New Source Review (NSR) was conducted resulting in VOC emission offsets and LAER limits. The requested change is not a major modification as defined by MCAQD Rules 100 or 240 and therefore Rule 240 does not apply to the requested significant permit revision (i.e. no additional NSR is required and NSPS remains unaffected). However, this does not alleviate the facility from meeting the applicable regulations, including the LAER requirements of Rule 240 Section 305.

VI. LAER

The original permitted LAER VOC limits for CC4 were established based on an assumed uncontrolled emission rate and assumed 30% reduction efficiency from the oxidation catalyst. Based on source emission tests of the CC4 unit, the limit has not been achieved on a routine bases. In addition, no other similar sized unit appears to have as stringent of a limit as CC4. CC4 is subject to LAER since it is in the ozone non-attainment area of Maricopa County. A four-step process was used to arrive at a revised LAER emissions limit applicable to CC4:

1. Review of the U.S. EPA's RACT/BACT/LAER Clearinghouse (RBLC) for combustion turbines and duct burners.
2. Review of the California South Coast Air Quality Management District (SCAQMD) and California Air Resources Board (CARB) BACT and LAER permitting decisions for combined cycle combustion turbines and duct burners.
3. Comparison of the RBLC, SCAQMD, and CARB permitting decisions to actual source test data from CC4 for the combustion turbine and duct burners.
4. Selection of a permit limit representative of LAER for the CC4 combustion turbine and duct burners.

In the above steps, both LAER and BACT permitting decisions were evaluated. This is due to the fact that APS has already installed a catalytic oxidizer. To date, no post-combustion emission control system other than a catalytic oxidizer has been shown to be feasible for VOC control, regardless of cost. Catalytic oxidizers have been installed both for BACT and for LAER. Therefore, there is essentially no difference between BACT and LAER decisions if the facility has a catalytic oxidizer.

RBLC Information

Attachment 1 is a copy of "Appendix A" provided by APS as part of its permit revision application. The data in Appendix A were spot checked and it appears to be an accurate summary of RBLC permitting decisions for natural gas-fueled combustion turbines.

Table 1 of Appendix A is a list of gas turbine emission limit determinations in the RBLC, both large and small and simple as well as combined cycle units. Table 2 is a subset of Table 1, and is a list of RBLC combined cycle (only) units less than 140 MW in size. Simple cycle units were excluded from further consideration due to significant difference in physical operation of a simple cycle turbine and a combined cycle turbine. Simple cycle turbines attempt to extract as much energy as possible from a single expansion of hot gases, while a combined cycle system extracts energy from both the single hot gas expansion and the remaining heat in the exhaust gases. Therefore, the simple cycle and combined cycle units operate at different temperatures, air flow rates, and pressures.

In addition to eliminating simple cycle turbines from further consideration, units larger than 140 MW were also excluded. The CC4 unit is a General Electric model 7EA with an ISO Base rating of 84.4 MW. (ISO ratings are a standard method of specifying energy output at sea level pressures, 59 degrees F, and 60% relative humidity. ISO ratings do not necessarily indicate the actual energy output that will be achieved under site-specific conditions.) The next larger General Electric model is the 7FA. The 7FA units have an ISO rating of 171.7 MW. Westinghouse and other turbine manufacturers have a similar size distinction among units.

Most of the combined cycle combustion turbines installed over the last several years are the General Electric 7FA or newer units (or equivalent from other manufacturers). These units are on the order of 170 MW or larger. Each generation of combustion turbine (designated with the letters E, F, G, etc.) are designed to be more energy efficient with lower emissions. This is generally achieved by increasing the combustion temperatures and operating pressures. Combustion temperatures and pressures are generally limited by the strength of the metals and ceramics that can be used in the turbine. As advances in materials occur, the units can be made larger and more efficient.

According to the General Electric publication #GER-3571E, the firing (combustion) temperature of the 7EA unit is about 2,000 degrees F, while the 7FA unit is about 2,400 degrees F. Higher temperatures mean more efficient fuel combustion and less VOC emissions as they are destroyed in the combustion process. Accordingly, it is not representative to compare VOC emission limits for 7FA units to 7EA units. Since not all of the units in the RBLC database are General Electric, and in some cases the specific model of the permitted unit is not listed, a size cutoff of 140 MW was used to represent units that are

most likely of the 7EA vintage from units that are of the 7FA or larger vintage. As an example that the 170 MW cutoff represents a break point between FA-vintage units versus EA-vintage is the Millenium Power Partners (Massachusetts) Westinghouse 501G model combined cycle combustion turbine. The 501G is the current (2006) most advanced Westinghouse unit, comparable to the General Electric 7FA units. The Millenium Power Partners unit is rated at 230 MW, and has a firing temperature of on the order of 2,700+ degrees F. This unit has a heat input rating of 2,534 mmBtu/hour (according to the permit issued by the Massachusetts Department of Environmental Protection); which is nearly triple the heat input of CC4. Thus the 140 MW cutoff for all model units appears more than adequate, and Table 2 of Appendix A represents only units less than 140 MW.

To provide justification for the selection of the combustion turbines that were used to make equitable VOC emissions comparisons in the West Phoenix BACT/LAER Reevaluation Report, APS recently prepared a document1 that details the design and performance differences among combustion turbines. The document compares the GE 7EA turbine, which is the model located at the West Phoenix Power Plant, and next generational turbine design, the GE 7FA. These two models were compared to illustrate the substantial differences in the design and performance characteristics that exist between different turbine models, and how these differences can affect the resultant emissions. The document explains how the turbine design and performance differences cause variances in emissions due to the differences in combustion techniques and firing temperatures.

Subsequently, an interest has been expressed in a comparison between the West Phoenix GE 7EA turbine and the Millennium Power Partners Siemens-Westinghouse W501G turbine. The W501G is considered the current state-of-the-art, advanced technology combustion turbine. It is the next generational design from the F-series turbines. The design enhancements of the G-series turbines focus on reducing emissions, improving performance, availability, and reliability, and extending inspection intervals. Specifically, the major design enhancements of the G-series turbines are the incorporation of steam-

1 Design and Performance Variations of Combustion Turbines

cooled combustion system components and other advanced cooling technologies, enhanced transitions, and improvements in the compressor, combustor, transition, and turbine seals. These design enhancements allow the W501G combustion turbine to operate at a much higher firing temperature and pressure ratio, which results in lower emissions, an improved heat rate, and much higher power output.

Both the West Phoenix and Millennium turbines use an oxidation catalyst, which is the current best available control technology for controlling VOC emissions. The size of the catalyst at both facilities is essentially the same. The Millennium oxidation catalyst is 3.5 inches, and the West Phoenix oxidation catalyst is 3.0 inches. The West Phoenix oxidation catalyst was originally 2.0 inches, but another inch was added to see if additional catalyst would reduce VOC emissions. The additional catalyst did not have any discernable effect on the VOC emissions. Both facilities also use the same EPA Reference Method tests for determining VOC compliance.

Table 1 compares the different design characteristics of the 7EA and W501G combustion turbines.

Table 1

Model	ISO Base Rating (kW)	Heat Rate (BTU/kWh) LHV	Firing Temp. (Degrees F)	Exhaust Temp (Degrees F)	Pressure Ratio
7EA	84,360	10,480	2,020	998	12.7
W501G	266,000	8,682	2,700 – 2,8002	1,108	20.1

Table 2 shows a comparison of emissions data of the West Phoenix 7EA and the

2 The exact firing temperature of the Millennium turbine could not be obtained. Moreover, Siemens considers combustion turbine firing temperatures to be proprietary information and will only provide a range of typical firing temperatures.

Millennium W501G combustion turbine.

Table 2

Unit	VOC Limits			Heat Input (mmbtu/hr)	Pollution Controls	Required Compliance Testing	Methods
	lb/hr	ppm	lb/mmbtu				
West Phoenix 7EA (current)	.26	1.0	0.0013	94 4.4	Oxidation Catalyst	Annually	25a/18
(proposed)	.27	2.0	0.0024				
Millennium W501G	.7	3.0	0.0013	2,534	Oxidation Catalyst	Once	25a/18

As illustrated in Table 2, the Millennium VOC concentration (ppm) and mass emissions rate (lb/hr) limits are higher than both the current and proposed VOC limits for the West Phoenix 7EA turbine. The similarity in the lb/mmbtu limit is due solely to the much high heat input for the advance technology Millennium turbine. It is quite uncertain if the Millennium turbine would be able to achieve any of its VOC limits if it were operated at a firing temperature similar to that of the 7EA. For example, the Millennium turbine could not meet its VOC limit at the lower-load (50%) compliance test. Compliance was not be demonstrated until the turbine was at 62% load. Furthermore, the Millennium permit only required one compliance test. Once the

Millennium turbine was able to demonstrate compliance with the VOC limits, no further VOC testing of the turbine has occurred. Accordingly, it is unknown as to whether Millennium could consistently achieve the current VOC limits with subsequent and on-going compliance tests, such as required of the West Phoenix 7EA turbine.

Table 3 of Appendix A is a listing of combined cycle units smaller than 140 MW for which the RBLC indicates the emission limit was specified as LAER. However, as shown in Table 2, some BACT permitting decisions in the RBLC database have resulted in emissions limits lower than those reported as LAER. Table 2 includes both LAER and BACT permitting decisions. Therefore, Table 2 is the most relevant for evaluating RBLC emission limits.

As shown in Appendix A Tables 2 and 3, the RBLC permitted emission limits do not all have the same units. Therefore, to compare emission limits, the following methods were used to calculate an equivalent emission limit in pounds per million Btu.

1. To estimate the equivalent emission rate in pounds per million Btu for permit limits reported in parts per million:

$$E = \frac{C_h K F_c (20.9)}{20.9 - \%O_2}$$

where,	E =		VOC pollutant emission rate, lb/mmBtu
	C_h =		Hourly average VOC concentration as limit, ppmvd
	F_c =	8,710	dscf/mmBtu (Natural Gas)
	$\%O_2$ =	15.0	Oxygen concentration, percent by volume.
	K =	8.13×10^{-8}	lb/dscf-ppm VOC (as ethane)

As an example, 2.0 ppmvd VOC at 15% oxygen converts to 0.0050 lb/mmBtu as ethane. The same 2.0 ppmvd VOC converts to 0.0027 lb/mmBtu as methane. This is due to the fact that the ppm is volume to volume, independent of the type of gas. However, on a mass basis, the molecular weight of methane is 16, while ethane is 30. Therefore, for the same ppm, the mass of methane is 16/30 times the mass of ethane. If the same 2.0 ppmvd VOC was reported as propane, the mass rate would be 0.0073 lb/mmBtu, because the molecular weight of propane is 44, so the mass of propane is 44/30 that of ethane.

Source tests are often reported as methane, sometimes as ethane, and sometimes as propane. However, rarely do the reported RBLC limits specify the mass reporting parameter. Therefore, the unit conversions for the RBLC data were made as ethane, the midpoint between methane and propane. Note that this conversion only applies when the RBLC emission limit is in terms of ppmvd.

2. To estimate the equivalent emission rate in pounds per million Btu for permit limits reported in pounds per hour and a throughput reported in MW, the unit heat rate was assumed to be 10,000 Btu per kWh. The megawatt rating was converted to mmBtu/hr

with the following formula:

mmBtu/hr = MW x 10000 Btu/KW-hr x 1000 KW/MW x 1 mmBtu/10^6 Btu

3. To estimate the equivalent emission rate in pounds per million Btu for permit limits reported in pounds per hour and a throughput reported in mmBtu/hr (or throughput converted to mmBtu/hr as noted above), the equivalent emission rate is calculated as follows:

   lb/mmBtu = lb/hr divided by mmBtu/hr.

The following Table VI-1 was extracted from Appendix A Table 2 (for combustion turbines) and Appendix A Table 4 (for duct burners) in order to summarize the most stringent permit limits in the RBLC. The list is shown in ascending order by VOC permit limit in equivalent units of lb/mmBtu. Review of each unit on this list was conducted starting with the most stringent emission limit. If the permit limit had not been demonstrated achievable (for example, the unit had not yet been constructed) it was eliminated from further consideration. The most stringent emission limit that has been demonstrated achievable was then used in the next steps.

Although the most relevant parameter for emissions and environmental impact purposes is a mass emission rate (e.g., lb/hr or lb/mmBtu), at times, the ppmvd value is used to report emissions and limits. Therefore, in Table VI-1, a column has been added to reflect the equivalent limit in terms of ppmvd. All of the emission limits in Table VI-1 were reported by the RBLC in terms of mass. Since the most common reporting format is “as methane” at 15% oxygen, in order to convert the mass emission rates to ppmvd, it was assumed that the mass emission rates were “as methane” and 15% oxygen

Table VI-1
LAER Summary and Justification

RBLC ID	FACILITY NAME	STATE	REGION	PERMIT DATE	PROCESS NAME	THRUPUT UNITS	EMISSION LIMIT	UNITS	EQUIVALENT LIMIT, lb/mmBtu	EQUIVALENT LIMIT, ppmvd @ 15% O2	CASE-BY-CASE BASIS	JUSTIFICATION FOR ELIMINATING FROM FURTHER CONSIDER-ATION
Combustion Turbine LAER Review												
TX-0351	WEATHERFORD ELECTRIC GENE	TX	6	03/11/02	(2) GE7121EA GAS TURBINES, S 3&4	1079 MMBTU/H	2.00	LB/H	0.0019	1.42	**NOT CON-STRUCTED**	Not Constructed
FL-0078	KISSIMMEE UTILITY AUTHORITY	FL	4	12/21/99	TURBINE, NATURAL GAS, UNIT 2	869 MMBTU/H	2.00	LB/H	0.0023	1.72	BACT-PSD	Only 1 source test -Not shown to be achieved on a routine basis
TX-0259	FREEPORT CONGENERATION FAC	TX	6	06/26/98	TURBINE/HRSG W/O DUCT BURNER	84 MW	2.04	LB/H	0.0024	1.79	Other Case-by-Case	Most Stringent Applicable to CC4
TX-0321	CR WING CONGENERATION PLANT	TX	6	10/12/99	CASE I: TURBINE E-1 FIRING GAS W	90 MW	2.20	LB/H	0.0024	1.79	Other Case-by-Case	
TX-0323	HIDALGO ENERGY FACILITY	TX	6	12/22/98	(3) EXIST GAS TURBINES, PHASE I	90 MW	2.20	LB/H	0.0024	1.79	Other Case-by-Case	
IN-0114	MIRANT SUGAR CREEK LLC	IN	5	07/24/02	TURBINE, COMBINED CYCLE, NATU	1491 MMBTU/H	0.0025	LB/MM BTU	0.0025	1.87	BACT-PSD	
CA-0950	VALERO REFINING COMPANY	CA	9	01/11/00	COMBUSTION TURBINE, COMBINED	102 MW	0.0025 (Note 1)	LB/MM BTU	0.0025	1.87	LAER	
GA-0079	GEORGIA POWER CO.-JACKSON	GA	4	08/09/99	TURBINE CT 1-16, NATURAL GAS)	978 MMBTU/H	0.0030	LB/MM BTU	0.0030	2.24	BACT-PSD	
Duct Burner LAER Review												
MN 0054	MANKATO ENERGY CENTER	MN	5	12/04/03	DUCT BURNER, 2 EACH	800 MMBTU/H	3.40	PPMVD @ 15%	0.0085	3.40	NOT OPERATING	Not Operating
TX-0390	EAST REFINERY	TX	6	08/21/02	HRSG, NO.1 & 2 (2)	255 MMBTU/H	2.40	LB/H	0.0094	7.03	OTHER	Most Stringent Applicable
TX-0414	ATOFINA PETROCHEMICALS POR	TX	6	04/22/99	DUCT BURNER (2)	317 MMBTU/H	0.0100	LB/MM BTU	0.0100	7.47	BACT-PSD	

Note 1: The RBLC reported the Valero unit emissions as 2.0 lb/hr. However, the actual permit specifies 0.002515 lb/mmBtu. That value was used.

Table VI-1 indicates that the most stringent permitted emission limit for smaller combustion turbines is 0.0024 lb/mmBtu (or 1.8 ppmvd at 15% oxygen), and for the duct burner is 0.0094 lb/mmBtu (or 7.0 ppmvd at 15% oxygen). If these limits were applied to CC4, the combined (turbine plus duct burner) emission rate would be as follows:

> 0.0024 lb/mmBtu x 944.4 mmBtu/hr turbine + 0.0094 lb/mmBtu x 40 mmBtu/hr Duct burner = 2.27 lb/hr turbine + 0.38 lb/hr duct burner = 2.65 lb/hr (2.0 ppmvd @ 15% O_2).

If the 2.65 lb/hr were converted to an overall lb/mmBtu value, it would be:

> 2.65 lb/hr divided by (944.4 + 40) mmBtu/hr = 0.0027 lb/mmBtu (2.0 ppmvd @15% O_2) combined turbine and duct burner.

As noted, the RBLC information does not indicate whether or not the most stringent emission limits reported were as methane, ethane, or propane. Since methane tends to be the most common reporting parameter (see discussion following regarding CARB and SCAQMD), it will be assumed that the two most stringent RBLC emission limits are "as methane".

SCAQMD and CARB Information

The SCAQMD web site for BACT decisions was examined to determine the emission limits that the SCAQMD had recently permitted for combustion turbines. (In the SCAQMD, BACT is equivalent to LAER). Eleven permit decisions were recorded in the BACT database for combustion turbine BACT decisions made from 2001 to 2004. However, none of the permit decisions were made for the smaller General Electric EA combustion turbines. The VOC permit limits ranged from 1.0 ppmvd to 2.0 ppmvd, and averaging times from 1-hour to 24-hour. The limits were established for Westinghouse F and G models, General Electric FA models, one ABB GT-24 model, and one Alstom GTX100 model. Of the eleven permits, 4 had a permit limit of 1.4 ppmvd (at 15% oxygen), 3 had a permit limit of 1.0 ppmvd, and 4 had a permit limit of 2.0 ppmvd. The SCAQMD data are all reported "as methane." A limit of 1.4 ppmvd converts to 0.0019 lb/mmBtu as methane. A permit limit of 2.0 ppmvd converts to 0.0027 lb/mmBtu as methane.

The CARB has published guidance for combustion turbine BACT decisions. (The CARB BACT decisions are equivalent to LAER). This guidance suggests a 2.0 ppmvd, 1-hour average emission limit for BACT, equivalent to 0.0027 lb/mmBtu as methane. The guidance value is based on an uncontrolled emission rate of 4.0 ppmvd and an assumed 50% emission control from a catalytic oxidizer. However, review of the CARB BACT/LAER database shows that where there was a catalytic oxidizer installed, only 5 to 10% VOC emission reduction was assumed.

The CARB permit decision database indicated emission limits from 0.6 ppmvd to 18 ppmvd. Only one permitting decision was for a General Electric Frame EA, the SEPCO facility permitted by the Sacramento Air Quality Management District. The emission limit for the

SEPCO facility was reported as 3.7 pounds per hour combined total for the turbine and duct burners. The SEPCO facility is rated at 920 mmBtu/hr heat input to the turbine and 362.1 mmBtu/hr for the duct burners, a total of 1282.1 mmBtu heat input. The total emission rate can be converted to 0.0029 lb/mmBtu (2.2 ppmvd) for the turbine plus duct burners (3.7 lb/hr divided by 1282.1 mmBtu = 0.0029 lb/mmBtu). The emission rate was based on an assumed 5% VOC destruction efficiency in the catalytic oxidizer. However, the SEPCO facility was not built, so it is not clear whether those emission limits could be achieved. It is not known if the VOC mass was reported as methane, as ethane, or as propane. Since the unit was permitted in California, and CARB guidance reports emissions as methane, it is assumed that the SEPCO permitted limit was also "as methane."

In summary, CARB guidance specifies a BACT limit for the combustion turbine of 2.0 ppmvd, 1-hour average, equivalent to 0.0027 lb/mmBtu as methane. SCAQMD and CARB permit decisions are consistent with the guidance, although some of the larger, more modern units (General Electric FAs and similar size Westinghouse units) have been permitted at lower emission rates. Although the SEPCO facility was not built, it was permitted at 0.0029 lb/mmBtu (probably as methane) for the total of combustion turbine and duct burner. It appears that the RBLC data are at least as stringent, if not more stringent than the CARB and SCAQMD permitting decisions.

Unit CC4 Source Emission Tests

Tables VI-2 (without duct burners) and VI-3 (with duct burners) show the source test results for VOC from CC4 at high load. (Only high load results were evaluated since the annual source test requirements in the permit are for high load). The source test results show a wide variability (0.0001 to 0.0019 lb/mmBtu as methane) among the individual 1-hour runs for the turbine without duct burners. Table VI-2 shows that the current permit limit of 0.00133 lb/mmBtu cannot be reliably met. For the turbine-only, the average of the 13 runs is 0.0009 lb/mmBtu (0.7 ppmvd at 15% oxygen), with a standard deviation of 0.0006 lb/mmBtu (0.5 ppmvd). Based on these data, a 1-hour limit of 0.0021 lb/mmBtu or 1.6 ppmvd at 15% oxygen (i.e., 0.009 + 2 standard deviations) will be achieved 95% of the time, and a 1-hour limit of 0.0027 lb/mmBtu or 2.0 ppmvd at 15% oxygen will be achieved 99.7% of the time (i.e., 0.009 + 3 standard deviations).

Table VI-3 shows the results with both the combustion turbine and duct burners at full load. The average of the nine 1-hour runs is 0.0014 lb/mmBtu (1.1 ppmvd at 15% oxygen), with a standard deviation of 0.0004 lb/mmBtu (0.3 ppmvd at 15% oxygen). Based on these data, a 1-hour limit of 0.0022 (1.6 ppmvd at 15% oxygen) would be achieved 95% of the time, and a limit of 0.0026 (1.9 ppmvd at 15% oxygen) would be achieved 99.7% of the time. It is not too surprising that the source test data indicate that emissions with duct burners are about the same as without duct burners. This is due to the fact that the heat input of the turbine alone

is 944.4 mmBtu/hr and the duct burners add only 40 mmBtu/hr to the total heat input (only about 4% of the total). Therefore, the duct burner contribution to the total emissions is relatively small.

Table VI-2 - Normal Operation (Hi Load) Without Duct Burners

TEST DATE	POLLUTANT	RUN NUMBER 1	2	3	4	AVERAGE	LIMIT
August 2001	VOC (lb/hr)	2.50	0.64	0.32	0.34	0.95	1.26
	VOC (lb/mmBtu) as propane	0.0027	0.0007	0.0004	0.0004	0.0011	0.00133
	VOC (lb/mmBtu) as methane	0.0010	0.0003	0.0001	0.0001	0.0004	0.00133
	VOC (ppmvd @ 15% O2)	0.75	0.22	0.07	0.07	0.30	
October 2001	VOC (lb/hr)	1.70	0.80	0.27		0.92	1.26
	VOC (lb/mmBtu) as methane	0.0019	0.0009	0.0003		0.0010	0.00133
	VOC (ppmvd @ 15% O2)	1.42	0.67	0.22		0.75	
August 2004	VOC (lb/hr)	1.29	1.53	1.33		1.38	1.26
	VOC (lb/mmBtu) as methane	0.0014	0.0017	0.0015		0.0015	0.00133
	VOC (ppmvd @ 15% O2)	1.05	1.27	1.12		1.12	
September 2004	VOC (lb/hr)	0.49	0.49	0.55		0.51	1.26
	VOC (lb/mmBtu) as methane	0.0006	0.0006	0.0007		0.0006	0.00133
	VOC (ppmvd @ 15% O2)	0.45	0.45	0.52		0.45	

Table VI-3 - Normal Operation (Hi Load) With Duct Burners

TEST DATE	POLLUTANT	RUN NUMBER 1	2	3	AVERAGE	LIMIT
October 2001	VOC (lb/hr)	0.92	1.12	1.31	1.12	1.54
	VOC (lb/mmBtu) as methane	0.0010	0.0012	0.0015	0.0013	0.00156
	VOC (ppmvd @ 15% O2)	0.75	0.90	1.12	0.97	
June 2003	VOC (lb/hr)	1.39	0.59	1.52	1.17	1.54
	VOC (lb/mmBtu) as methane	0.0014	0.0007	0.0017	0.0013	0.00156
	VOC (ppmvd @ 15% O2)	1.05	0.52	1.27	0.97	
September 2005*	VOC (lb/hr)	1.53	1.23	1.41	1.39	1.54
	VOC (lb/mmBtu) as methane	0.0017	0.0016	0.0018	0.0017	0.00156
	VOC (ppmvd @ 15% O2)	1.27	1.20	1.35	1.27	

* Method 18 methane concentrations were subtracted from these numbers resulting in emission rates at or near zero.

Selection of LAER Emission Limits

The above analysis leads to the conclusion that LAER for CC4 VOC should be established at 0.0024 lb/mmBtu (1.8 ppmvd at 15% oxygen) without duct burners, and 0.0027 lb/mmBtu (2.0 ppmvd at 15% oxygen) with duct burners, reported as methane, rolling 3-hour average, to be confirmed through annual source emission testing using Method 25A. These values are based on the RBLC data; and are supported by the CARB BACT/LAER database, SCAQMD permitting decisions, and source test data for CC4 over the last 4 years as follows:

1. The RBLC most stringent emission limits for units the size of CC4 are 0.0024 lb/mmBtu (1.8 ppmvd at 15% oxygen) for turbines alone, and 0.0094 lb/mmBtu (7.0 ppmvd at 15% oxygen) for duct burners alone. Applying these limits to CC4 results in the following emission rates:

   0.0024 lb/mmBtu x 944.4 mmBtu/hr turbine + 0.0094 lb/mmBtu x 40 mmBtu/hr Duct burner = 2.27 lb/hr turbine + 0.38 lb/hr duct burner = 2.65 lb/hr (2.0 ppmvd at 15% oxygen).

   If the 2.65 lb/hr were converted to an overall lb/mmBtu value, it would be:

   2.65 lb/hr divided by (944.4 + 40) mmBtu/hr = 0.0027 lb/mmBtu combined turbine and duct burner (2.0 ppmvd at 15% oxygen).

2. The revised CC4 limit for the turbine alone (0.0024 lb/mmBtu or 1.8 ppmvd at 15% oxygen) is less than the CARB guidance (0.0027 lb/mmBtu as methane or 2.0 ppmvd at 15% oxygen, 1-hour average). Although there are some units permitted by SCAQMD with values less than the revised CC4 limits, those units were of the FA model and much larger than (and thus not representative of) the smaller CC4 EA model.
3. The revised CC4 limit for the turbine and duct burner combined is less than the SEPCO permitted value of 0.0029 lb/mmBtu (2.2 ppmvd at 15% oxygen) for a General Electric EA model unit.
4. The revised CC4 limits are within the 95% to 99.7% confidence level of actual test data from CC4, thus indicating that the revised CC4 limits are likely achievable at CC4.
5. A 3-hour average is used for the revised CC4 emission limits since the actual source test data indicate a significant hour to hour variation (a factor of 10 variability in three 1-hour runs taken consecutively).
6. The emission limits are specified "as methane" to be consistent with the majority of source test results and the CARB and SCAQMD permit limits.
7. Method 25A is specified as the applicable source test method for VOC since it has been demonstrated that Method 25 is not reliable below about 50 ppmvd (per

CARB BACT guidance). Method 25A is consistent with the CARB guidance.

VII. BACT

A BACT review is not applicable for this permit revision since only short-term VOC emission limits are affected and since the facility is located in an area designated as non-attainment for ozone (i.e. LAER is applicable instead of BACT for VOCs).

VIII. AIR QUALITY IMPACTS

The proposed permit revision only affects the short-term VOC emission rate from CC4. Based on EPA and MCAQD guidance and previous determinations, a separate air quality impact analysis is not considered necessary for this revision to VOC emission rates, as further discussed below.

A) Potential Ozone Impacts

The MCAQD and USEPA Region 9 approved modeling protocol for the 1999 West Phoenix Expansion project discussed why modeling analyses were not required for VOC emission increases even though VOC is an ozone precursor. This is because it is known that regional ozone concentrations are not significantly affected by emissions from an individual source, especially when the emissions are less 2.7 pounds per hour (less than 65 pounds per day). Also, when unit CC4 was originally permitted as part of the West Phoenix expansion, the potential annual VOC emission increases were offset by a greater level of emission decreases (an offset ratio of 1.2:1) in the allowable offset area (defined as the nonattainment area). . Therefore, no air modeling analyses for VOC/ozone were required in the original permit application. Since this permit revision does not change the annual emissions nor the offset requirements already achieved, there is no basis for ozone impact modeling associated with this revision.

The USEPA Emission Offset Interpretative Ruling, codified at 40 CFR Part 51 Appendix S, and the USEPA Emissions Trading Policy Statement, published at 51 FR 43829, December 4, 1986, describes the federal modeling requirements for nonattainment air quality impact analyses. For the nonattainment pollutants PM10, SO2, and CO, an air quality modeling analysis is typically required. However, according to this USEPA guidance, offsets for VOC and NO_X may be obtained anywhere within the nonattainment area in the broad vicinity of the proposed new source, and modeling is not required. This is because area-wide ozone and NO_X concentrations are not as dependent on specific individual sources and locations.

The USEPA Guidelines for Air Quality Modeling also briefly discuss VOC/ozone

modeling in Section 5.2.1. EPA states that simulation of ozone formation and transport is a highly complex and resource intensive exercise, not typically applied to assess the impact of an individual source on regional ozone concentrations. There are no standard USEPA approaches for an individual source ozone modeling analysis.

Accordingly in light of the above, no ozone impact modeling is required.

B) Potential Hazardous Air Pollutant Ambient Impacts

Since the VOC emissions contain some hazardous air pollutant (HAP) compounds, a review of the original Arizona Ambient Air Quality Guideline (AAAQG) analysis was conducted to evaluate whether the revised short term emissions would affect the original conclusions regarding AAAQG impacts from the West Phoenix facility. This review was limited to evaluating the original AAAQG impact analysis submitted with the original 1999 application for the West Phoenix expansion, including the addition of CC4. and for which the current permit was issued. Only VOC compounds) were evaluated. Since the revised emission increase is only for short term VOCs, annual AAAQG impacts and metal AAAQG impacts are unaffected. Table VIII-1 shows the initial AAAQG analysis results from the 1999 permit application. That analysis indicated that the short-term emission levels would have minimal off-site concentrations as compared with the AAAQG values (1-hr formaldehyde had the highest impact of 8.5% of the 1-hr AAAQG).

The original analysis was conducted in a conservative fashion by assuming the total facility emissions from the modified sources (including CC4 and CC5) are released from a single stack having the worst-case stack parameters, thus resulting in maximum hypothetical off-site concentrations. Based on this single stack approach, the modeled concentrations will increase linearly with emissions and can therefore be factored by multiplying the ratio of revised emission rates over the previous emission rates to obtain updated results. The analysis indicates that the combined HAP source emission rates would have to increase by a factor of more than ten (11.8) to exceed the AAAQG value for formaldehyde (the leading indicator).

The proposed increase in short term VOC emission rates for CC4 is 1.11 lb/hr (2.65 lb/hr - 1.54 lb/hr = 1.11 lb/hr). The sum of the originally permitted maximum short-term VOC emission rates for CC4 and CC5 combined is 6.92 lb/hr. Therefore, the revised emission limit will increase the combined CC4 and CC5 emissions by a factor of only 1.16 ([6.92 lb/hr + 1.11 lb/hr]/6.92 lb/hr = 1.16). Therefore, the revised emission increase will still result in off-site impacts well below AAAQG values, with formaldehyde having an estimated impact increasing from 8.5% to 9.9% of the 1-hr AAAQG value.

Table VIII-1 Modeling Results for affected AAAQG compounds

AAAQG Compound	Original Modeled Ambient Concentration (ug/m3)		Factored Ambient Concentration (ug/m3)		AAAQG (ug/m3)	
	1-Hour	24-Hour	1-Hour	24-Hour	1-Hour	24-Hour
Acetaldehyde (1)	1.0	0.28	1.2	0.32	2300	1400
Acrolein (1)	0.4	0.10	0.5	0.1	6.7	2
Benzene (1)	0.2	0.05	0.2	0.06	630	51
Formaldehyde (1)	1.7	0.45	2.0	0.52	20	12
Naphthalene (1)	0.0	0.01	0.0	0.01	630	400
Toluene (1)	1.1	0.29	1.3	0.34	4700	3000
Xylene (1)	0.4	0.10	0.5	0.1	5500	3500

IX. ADDITIONAL IMPACT ANALYSIS

The permit revision is not major modification under MCAPCR Rule 240, and thus the requirements for an additional air quality impact analysis pursuant to Rule 240 Section 508 do not apply. Nevertheless, the proposed permit revision does not change the impact analysis previously conducted with respect to growth, visibility, soils, vegetation, and endangered species.

X. REGULATORY STREAMLINING

The proposed significant permit revision will not affect the applicable regulations, including SIP and NSPS requirements, for which the most stringent conditions are already contained in the permit. The permit file contains a discussion of each of the applicable requirements and how the requirements have been streamlined to assure conformance with the most stringent requirement.

XI. CONCLUSION

Based on the information supplied by Arizona Public Service, and on the analyses conducted by the Maricopa County Air Quality Department, MCAQD has concluded that the current permitted VOC limits are not achievable on a routine basis and should be revised for Unit CC4 as follows:

Without duct burner: 2.27 lb/hr (0.0024 lb/mmBtu as methane), rolling 3-hour average
With duct burner: 2.65 lb/hr (0.0027 lb/mmBtu as methane), rolling 3-hour average

The revised permit limits will be in terms of a mass emission rate (lb/hr and lb/mmBtu). However, for reference, the 0.0024 lb/mmBtu as methane limit for the turbine alone is equivalent to 1.8 ppmvd at 15% oxygen. The 0.0027 lb/mmBtu as methane limit for the turbine and duct burners combined is 2.0 ppmvd at 15% oxygen.

This increase will not affect the SIP goals for ozone attainment (i.e., reasonable further progress) since there is no change to annual emissions and emission offsets were already obtained for Unit CC4 at a ratio of 1.2:1. Therefore, MCAQD intends to issue a revised permit to Arizona Public Service.

"APPENDIX A" SUBMITTED WITH THE ARIZONA PUBLIC SERVICE APPLICATION FOR PERMIT REVISION